



Armed Forces College of Medicine AFCM



Salivary Secretion

By

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INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture, the student will be able to:

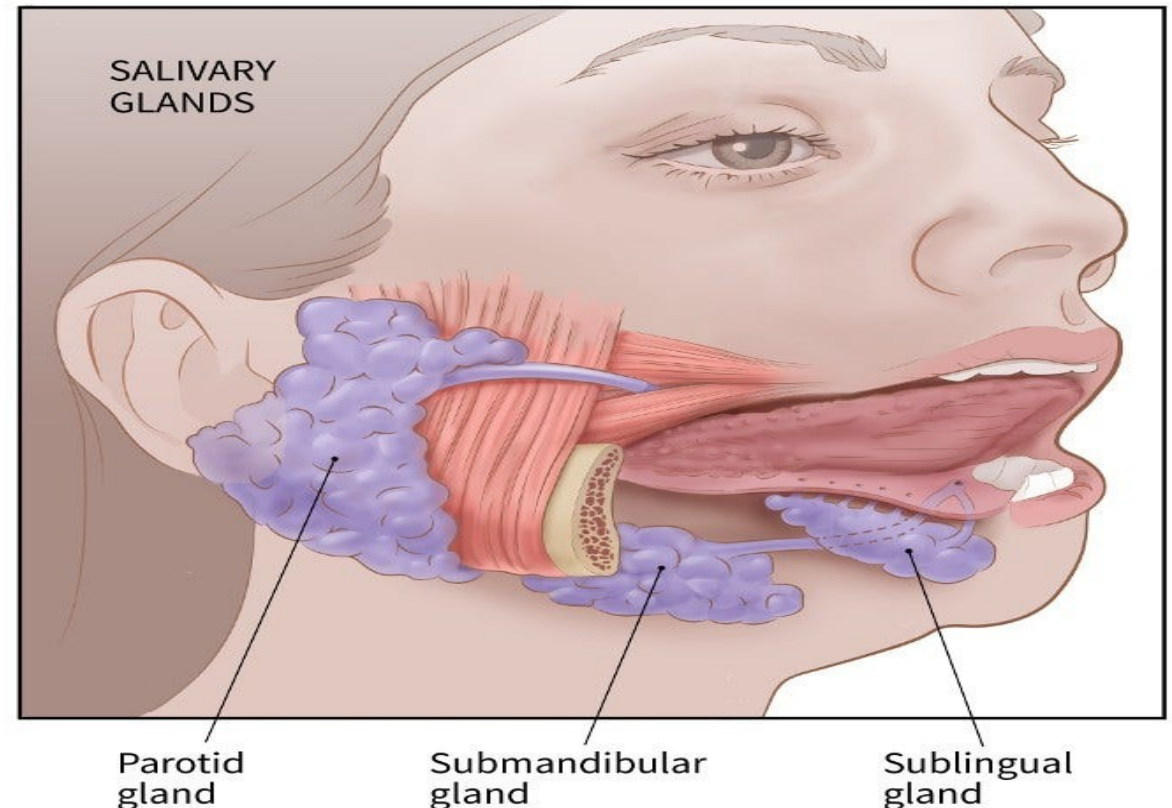
1. Describe the salivary secretion: volume, pH and composition.
2. Describe the different functions of saliva.
3. Explain the mechanism of salivary secretion.
4. Describe the regulation of salivary secretion.

Salivary Glands



- The first secretion encountered when food is ingested is saliva.
- Saliva is produced by 3 pairs of salivary glands that drain into the oral cavity, in addition to many small buccal glands.

1. The parotid glands.
2. The submandibular gland
3. The sublingual glands.



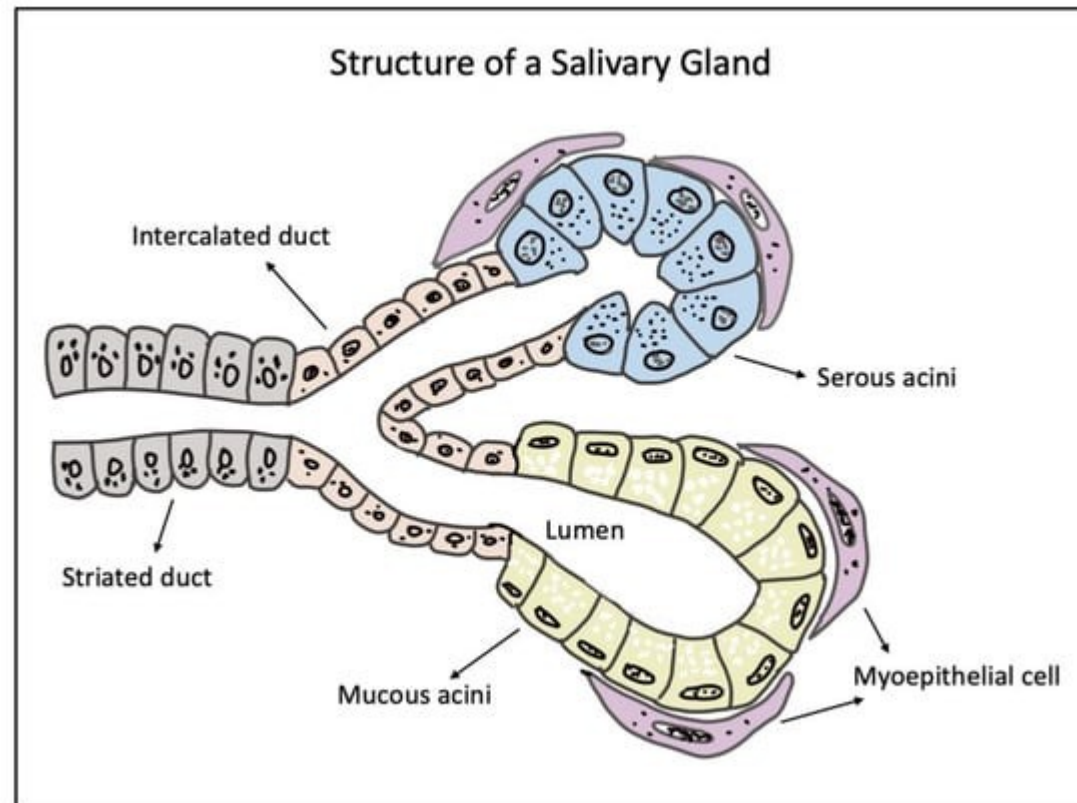
Salivary Glands



- Each salivary gland is formed of **acini**, which secrete a primary secretion that flows through the salivary **ducts**, which open into the oral cavity.
- The acinus is formed of two types of secretory cells

Mucous cells

Mucous (viscous) secretion containing mucin for lubrication & protection



Serous cells

Serous (watery) secretion containing ptyalin (α amylase enzyme) for digesting starch

Types of Salivary Glands



Parotid glands	Submandibular glands	Sublingual gland
20% serous watery secretion that <u>lacks</u> mucin glossopharyngeal nerve	75% mixed viscous saliva that <u>contains</u> mucin facial nerve	5% mixed viscous saliva that <u>contains</u> mucin. facial nerve

Characteristics of Saliva



- **Volume:** 800 and 1500 ml, average 1000 ml/day.
- **pH:** 6.0 and 7.0 (a favourable range for the digestive action of ptyalin)
- **Composition:** mainly water, organic (enzymes as ptyalin and mucin) and inorganic constituents (electrolytes e.g K^+ , HCO_3^- , Na^+ and Cl^-).

Water



99.5%

Solids



0.5%

Organic

Inorganic

α - amylase, lingual lipase, lysozyme, IgA , mucin and lactoferrin

K^+ , HCO_3^- , Na^+ and Cl^-

Table 64–1**Daily Secretion of Intestinal Juices**

	Daily Volume (ml)	pH
Saliva	1000	6.0–7.0
Gastric secretion	1500	1.0–3.5
Pancreatic secretion	1000	8.0–8.3
Bile	1000	7.8
Small intestine secretion	1800	7.5–8.0
Brunner's gland secretion	200	8.0–8.9
Large intestinal secretion	200	7.5–8.0
Total	6700	

Mechanism of salivary secretion



Salivary secretion consists of two stages

The first stage: a primary secretion that contains **ptyalin** and/or **mucin** in a solution of **ions** which shows no great difference from extracellular fluid and isotonic.

The second stage: modification occurs along the **ducts**.

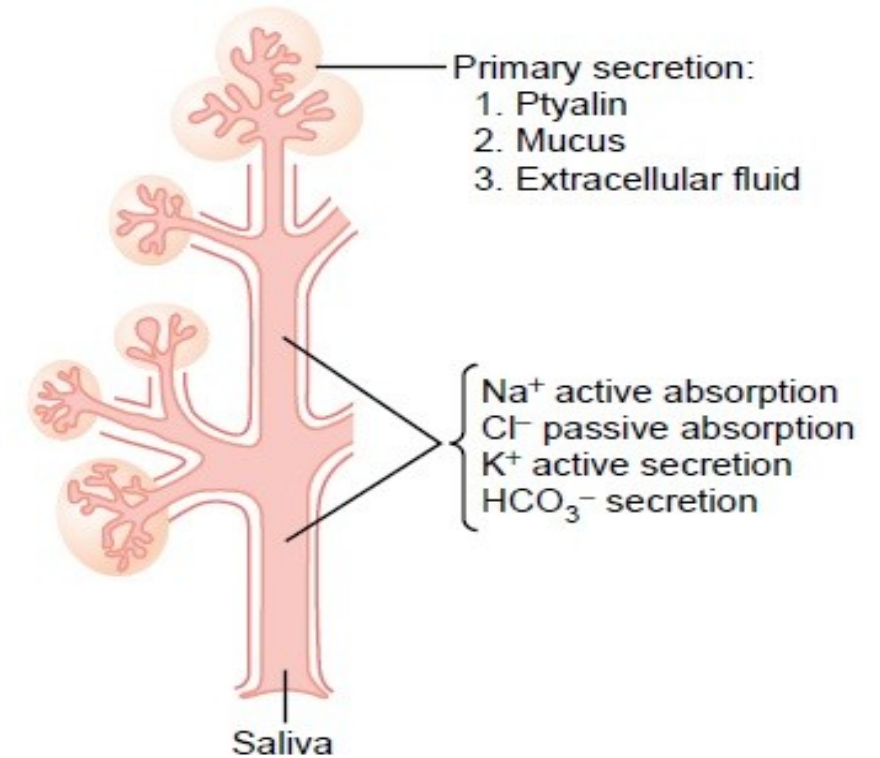


Figure 64-2

Formation and secretion of saliva by a submandibular salivary gland.

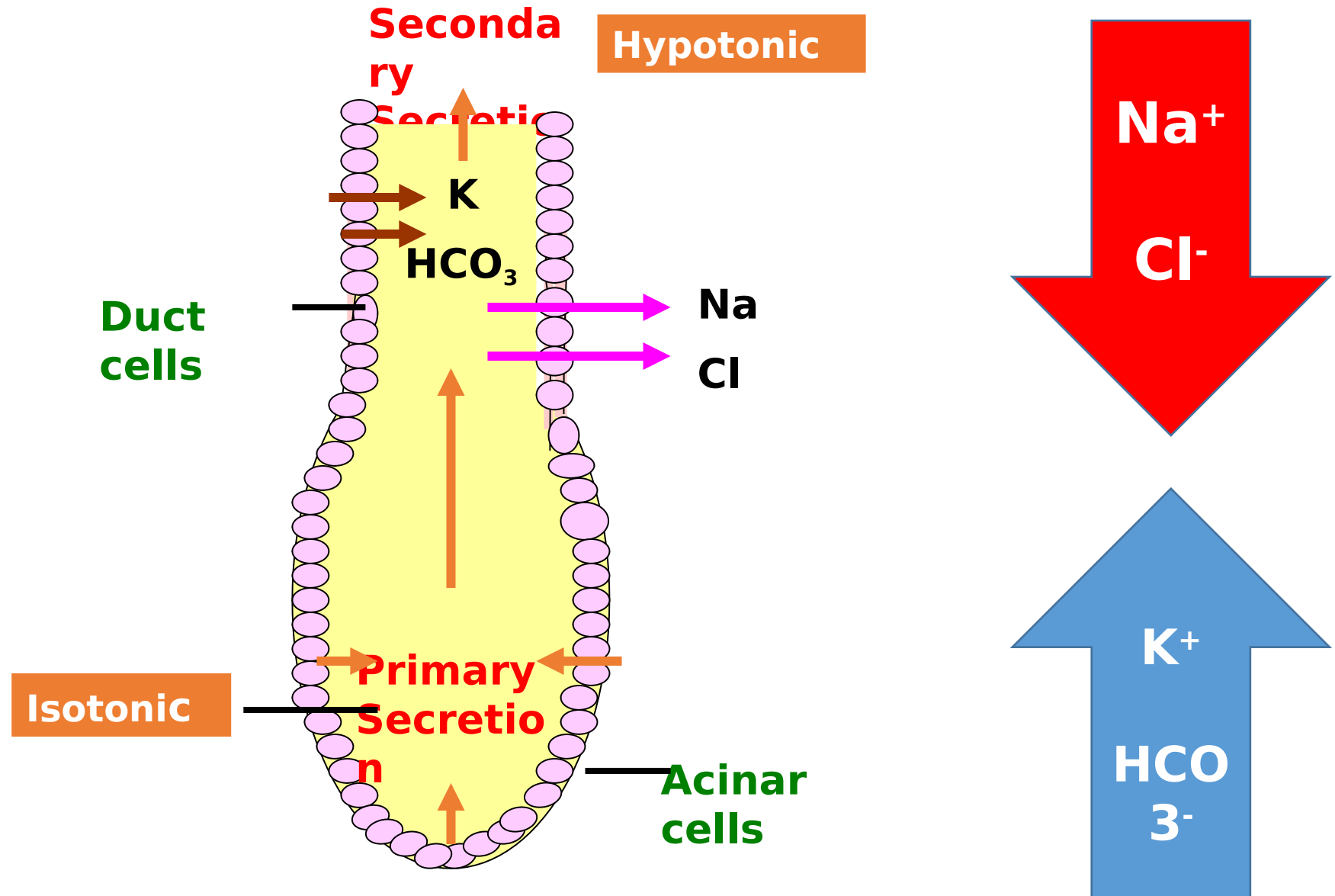
1. Sodium ions (Na^+) are actively reabsorbed.

2. Potassium ions (K^+) are actively secreted.

3. Bicarbonate ions (HCO_3^-) are actively secreted into the lumen of the duct.

4. Water is not reabsorbed. Therefore, the saliva that reaches the mouth is

Mechanism of salivary secretion



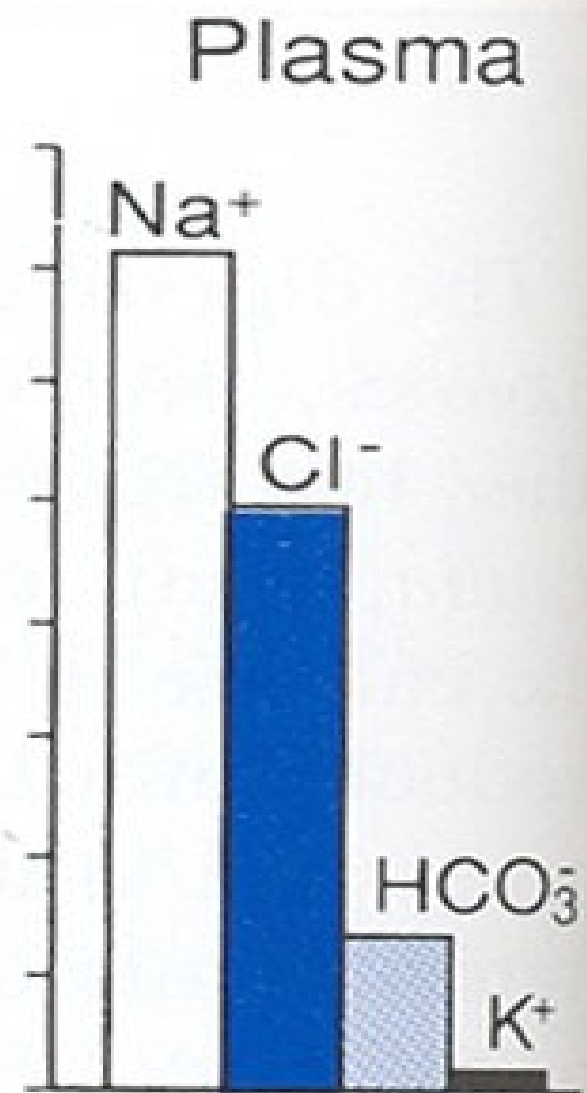
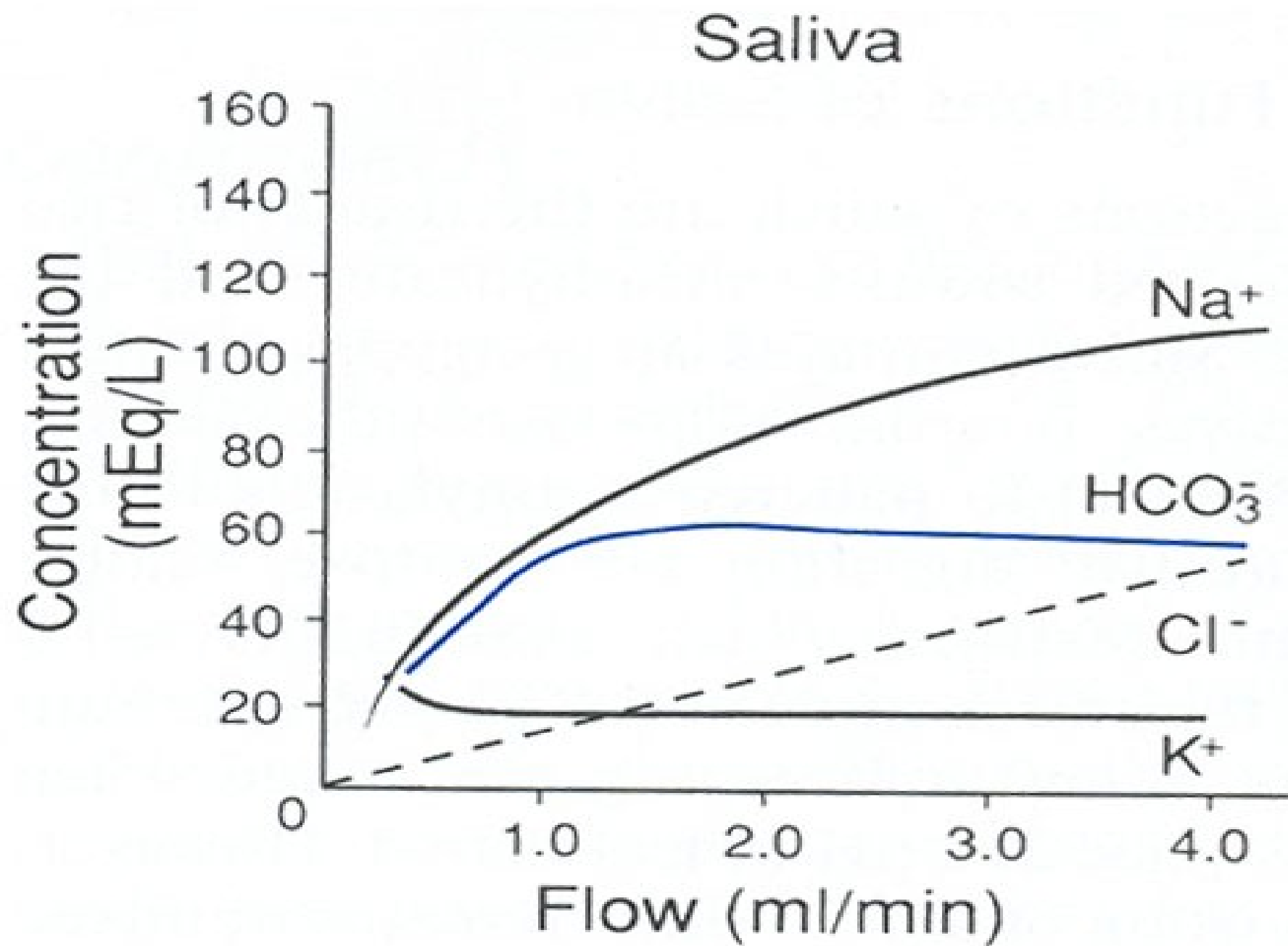
Mechanism of salivary secretion



- The net result of these transport processes under **resting** conditions makes
 - The concentration of **Na⁺ and Cl⁻** in saliva **lower**, than in plasma.
 - The concentrations of **K⁺ and HCO₃⁻** in saliva **higher** than in plasma.
- During parasympathetic stimulation (**maximal** salivation), there is less time for NaCl to be extracted and the tonicity of the saliva rises, but it always stays somewhat hypotonic with respect to plasma.

N.B

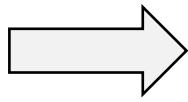
Aldosterone increases the K⁺ concentration and reduces the Na⁺ concentration of saliva.



Functions of Saliva



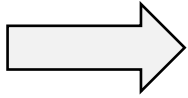
A



Articulation:

✓ Keeping mouth moist facilitates movements of the lips and tongue during speech

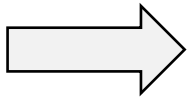
B



Buffer function:

✓ The saliva contains bicarbonate which **neutralizes acids** present in food or produced by bacteria in mouth (so prevent dental caries) or even the gastric acid if gastric juice is abnormally regurgitated into the esophagus (so relieve heartburn).

C



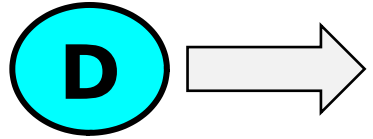
Cleaning function:

✓ Thus, help to maintain oral pH at about 7.0.
✓ Maintaining healthy oral mucosa by:

1. Washing away pathogenic bacteria & food remnants.
 2. Lysozyme attacks the walls of bacteria.
 3. Antibodies (IgA) destroy pathogenic bacteria
 4. Lactoferrin is a bacteriostatic
- ✓ Cooling of hot food (protective function).

Cooling Function:

Functions of Saliva



Deglutition:

✓ Saliva contains **mucins** (glycoproteins) that lubricates the food, facilitating its swallowing

Digestion:

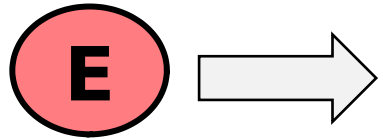
✓ **Ptyalin (α -amylase):**

- cleaves α -1,4-glycosidic bonds of starch.
- optimum pH 7.

Products of digestion: **α dextrins, maltotriose & maltose.**

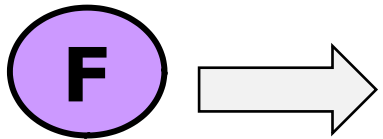
✓ **Lingual lipase:**

- Triglycerides



Excretory Function:

optimum pH is low, so it remains active in mouth.
✓ Excretion of waste products as fluorides, urea, lead...



Facilitate (+) of taste buds:

✓ Saliva acts as a solvent for the molecules that stimulate taste receptors.

Functions of Saliva



How does saliva protect oral mucosa???

1. Cooling hot foods.
2. Neutralizing acid.
3. Maintaining healthy oral mucosa by washing away pathogenic bacteria and food remnants, **Lysozyme** (attacks the walls of bacteria), **IgA** (destroys bacteria) and **Lactoferrin** (bacteriostatic)



How does saliva protect teeth???

1. The buffers keep the oral pH at 7.0.
2. Fluoride protects the teeth enamel.
3. Proline-rich proteins protect teeth enamel and bind to tannins.





Innervation of salivary glands:

I) Parasympathetic innervation:

- Profuse secretion of watery saliva high in electrolytes and low content of organic material.

- Vasodilatation in the gland which is **due to local release of**

II) Sympathetic innervation:

- Secretion of a small amount of saliva rich in organic constituents.
- Vasoconstriction.

What is the cause of basal salivary secretion???

Constant low-level stimulation by the Parasympathetic nerves

Control of Salivary Secretion

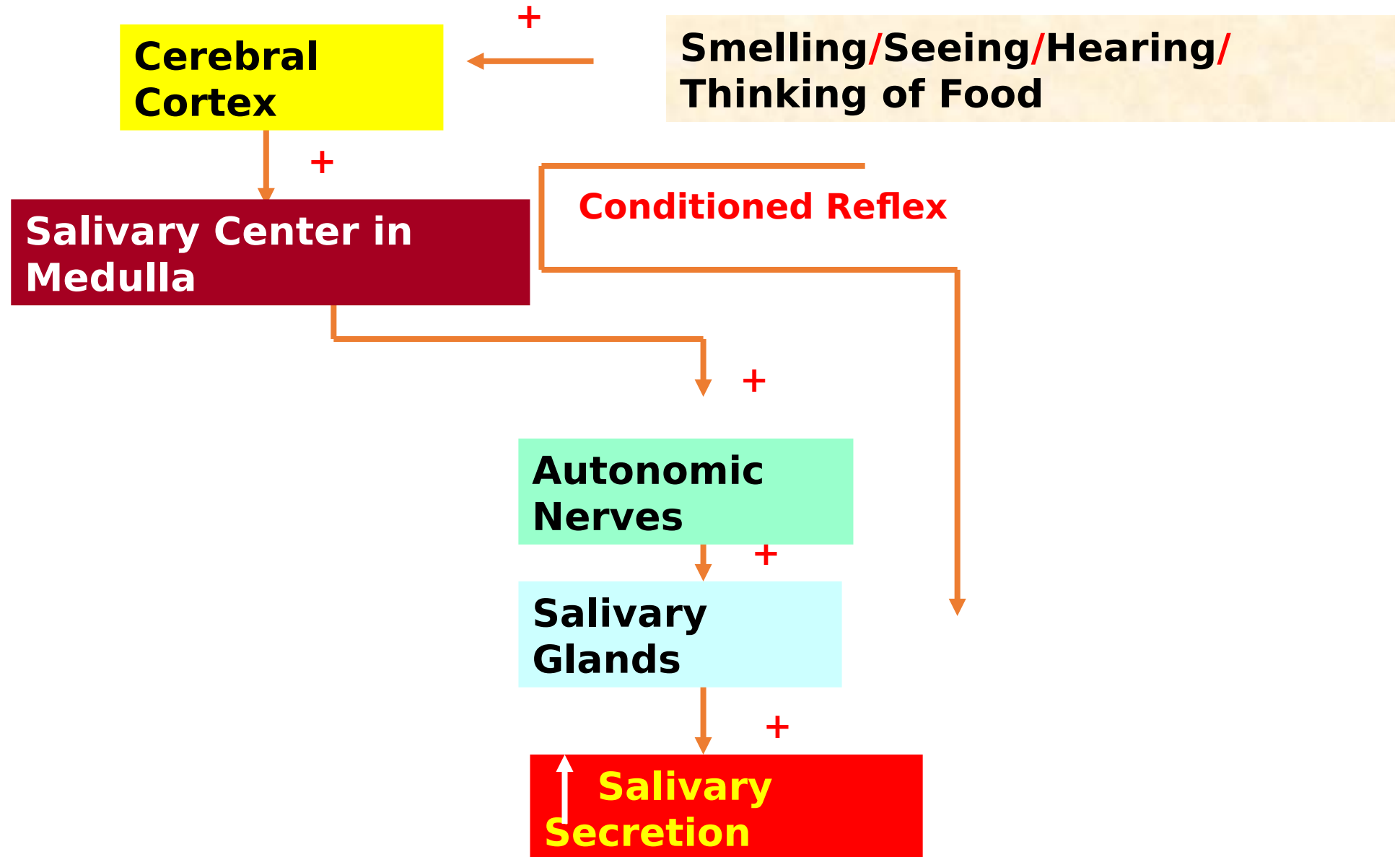


- Salivary secretions are regulated by **NERVOUS** mechanisms only.
- Secretion of saliva can occur in response to conditioned or unconditioned stimuli.

1. Conditioned Reflexes:

- Sight, smell, hearing of food and even thinking of food result in reflex increase in the secretion of saliva
- An **acquired** reflex and needs training.
- ✓ **Stimulus:** The sight, smell, thought of food in the absence of food in the mouth.
- ✓ **Receptors:** special sense receptors.
- ✓ **Afferent:** optic, olfactory, auditory nerves.
- ✓ **Center:** cerebral cortex then salivary nuclei in medulla oblongata (in brain stem).
- ✓ **Efferent:** autonomic nerves supplying salivary glands e.g chorda tympani & glossopharyngeal.
- ✓ **Response:** **increase** salivary secretion.

Control of Salivary Secretion (conditioned reflex)



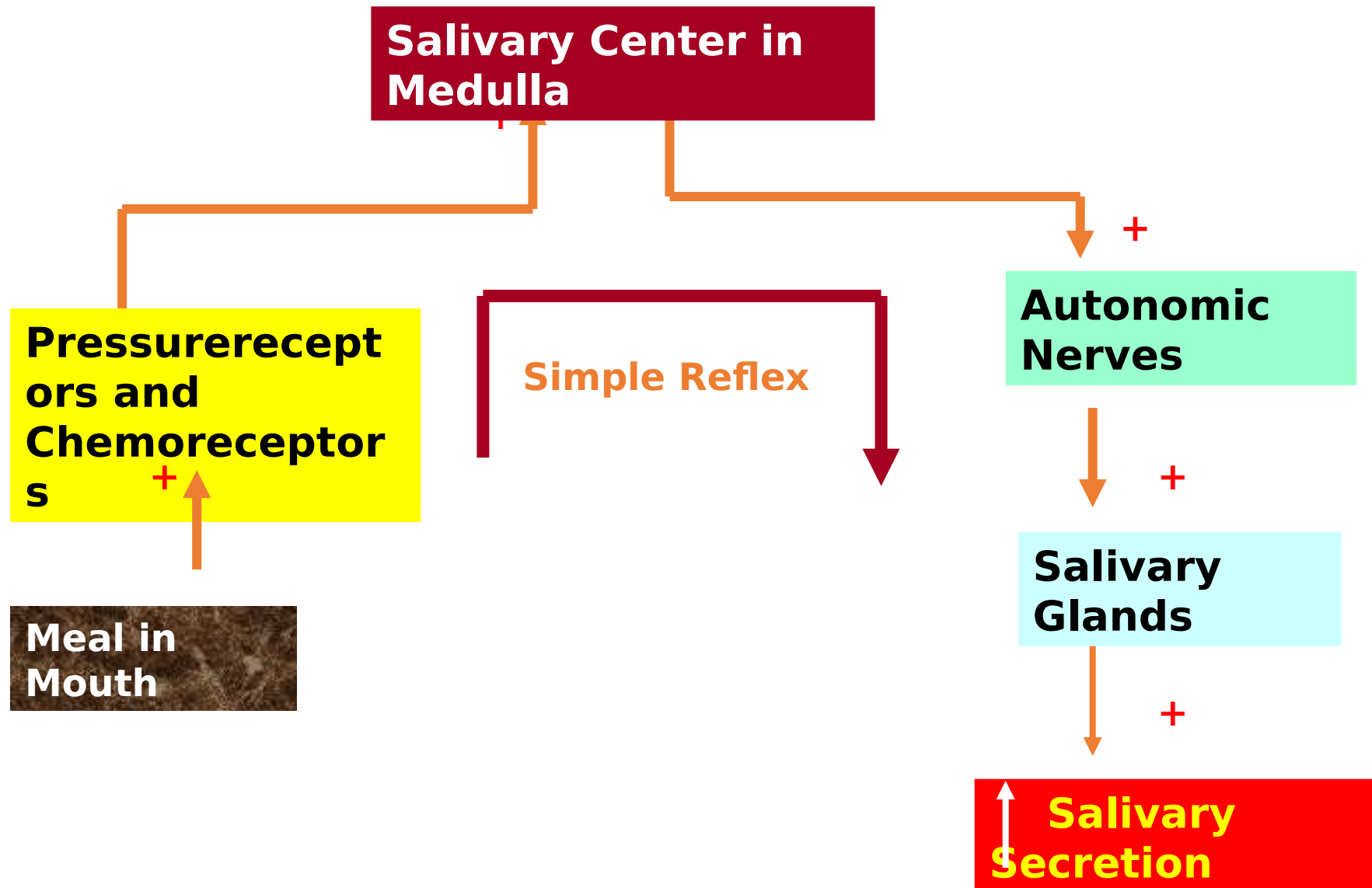
Control of Salivary Secretion (unconditioned reflexes)



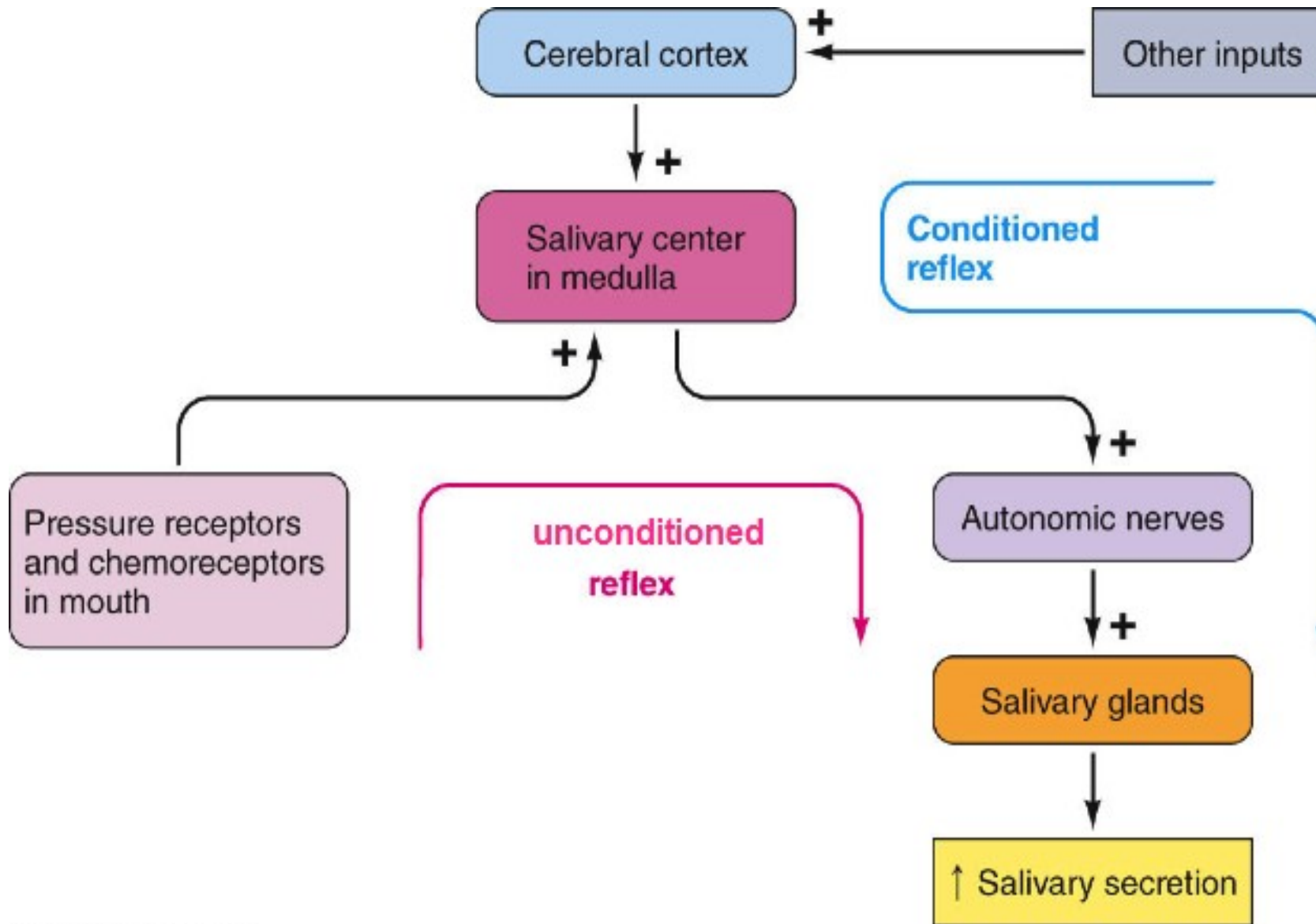
2. Unconditioned Reflexes:

- The presence of food in the mouth results in reflex secretion of saliva.
- **Inborn** reflexes, don't require previous training.
- ✓ **Stimulus:** presence of food in the mouth.
- ✓ **Receptors:** taste buds.
- ✓ **Afferent:** nerves from taste buds
 - Chorda tympani from ant. 2/3 of tongue.
 - Glossopharyngeal from post. 1/3 of tongue.
 - Vagus from epiglottis.
- ✓ **Centre:** salivary centre in medulla oblongata (in brain stem).
- ✓ **Efferent:** autonomic nerves supplying salivary glands e.g. chorda tympani & glossopharyngeal.
- ✓ **Response:** **increase** salivary secretion.

Control of Salivary Secretion (unconditioned reflexes)



Regulation of salivary secretion





Which of the following is characteristic of saliva?

- a. Hypotonicity relative to plasma
- b. A lower HCO_3^- concentration than plasma
- c. The presence of protease
- d. Secretion rate that is increased by vagotomy
- e. Modification by the salivary ductal cells involve reabsorption of K^+ and HCO_3^-

SUGGESTED TEXTBOOKS



- Guton and Hall 11th edition textbook: Chapter 65 ;
Secretory Functions of the Alimentary Tract (unit XII),
pages 809&810.
- Ganong's 25th edition: section IV , gastrointestinal
physiology; page 1046-1048



Thank you